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(71) Applicant *(for all designated States except US)*: KONINKLIJKE PHILIPS ELECTRONICS N.V. [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: VAN ZON, Joannes, B., A., D. [NL/NL]; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).

(74) Agent: SCHRIJNEMAEKERS, Hubert, J., M.; Internationaal Octrooibureau B.V., Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).

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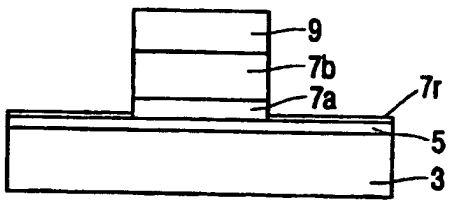
WO 01/08176 A1

(54) Title: METHOD OF MANUFACTURING A MAGNETIC TUNNEL JUNCTION DEVICE



(57) Abstract: A method of manufacturing a magnetic tunnel junction device, in which a stack (1) comprising two electrode layers (3, 7) and a barrier layer (5) extending in between is formed. One of the electrode layers is structured by means of etching, in which, during etching, a part of this layer is made thinner by removing material until a rest layer (7r) remains. This rest layer is subsequently removed by means of physical etching, in which at least substantially charged particles have a motion energy which is between the sputtering threshold of the magnetic material of the rest layer and the sputtering threshold of the non-magnetic material of the barrier layer. In the relevant method, it is prevented that the electrode layer which is not to be structured is detrimentally influenced during structuring of the other electrode layer.

Method of manufacturing a magnetic tunnel junction device.

The invention relates to a method of manufacturing a magnetic tunnel junction device, in which a stack comprising two electrode layers, comprising a magnetic material, and a barrier layer extending in between, comprising a non-magnetic material, is formed.

The invention also relates to a magnetic tunnel junction device obtainable by means of such a method, a magnetic field sensor provided with such a device and a magnetic memory provided with such a device.

A device as described above is disclosed in WO-A 99/22368. The magnetic tunnel junction device known from said patent application comprises a first and a second magnetic layer, which layers are sandwiched with respect to an insulating intermediate layer and serve as electrode layers. As a transducing element, this device forms part of a magnetic field sensor provided with a magnetic yoke, in which the first magnetic layer is in direct contact with a part of the yoke. The first magnetic layer, likewise as the yoke, is formed from a soft-magnetic material. The second magnetic layer is a composite layer and comprises a ferromagnetic sub-layer and a pinning structure. The insulating intermediate layer constitutes a tunnel barrier.

In the known magnetic tunnel junction device, one of the magnetic layers, namely the soft-magnetic layer, therefore also serves as a flux guide. To prevent detrimental effects on the magnetical properties of this layer, such as domain wall formation due to irregularities in the surface of the soft-magnetic layer facing the tunnel barrier, it is desirable that only the other magnetic layer, i.e. the second magnetic layer, and possibly the barrier-forming intermediate layer, is, or are, structured.

It is an object of the invention to provide a method of the type described in the opening paragraph, comprising a process of structuring one of the electrode layers, which process stops with certainty before the other electrode layer is reached.

To achieve the object described, the method according to the invention is characterized in that one of the electrode layers is structured by means of etching, in which, during etching, a part of the relevant layer is made thinner by removing material until a rest layer remains, whereafter this rest layer is removed by means of physical etching, in which at

least substantially particles have a motion energy which is between the sputtering threshold of the magnetic material of the rest layer and the sputtering threshold of the non-magnetic material of the barrier layer. Physical etching is understood to mean etching by means of a beam of electrically charged particles, such as sputter etching, ion milling and ion beam etching. As is assumed to be known, the sputtering threshold is the minimal energy which is necessary to release a particle from the material of the layer which is subjected to an etching process.

In the method according to the invention, it is with certainty that the other electrode layer is not reached because the electrode layer to be structured is not entirely etched off during a first phase of the etching process in which use is made in known manner of a mask of the electrode layer to be structured which is or may comprise a soft-magnetic layer. Etching during the first phase may be chemical or physical etching. By performing, for example, resistance measurements, it can be determined when the rest layer is reached. Preferably, a rest layer having a thickness of maximally 5 nm is aimed at. During a second phase of the etching process, the rest layer is removed by way of physical etching without the other electrode layer being attacked. This surprising effect is achieved in that the particles used during physical etching have a motion energy which is lower than the sputtering threshold of the barrier layer and can therefore not pass through the barrier layer. The physical etching process used is thus a selective etching process. The steps of the method mentioned above do not cause any detrimental effect on the non-structured electrode layer; particularly there is no detrimental influence of the magnetical properties of this electrode layer. If the last-mentioned layer is formed from or also from a soft-magnetic material, this layer is particularly suitable for use as a flux-guiding layer.

An embodiment of the method according to the invention is characterized in that particles are used which have a mass which is heavier than the mass of a metallic element of the magnetic material of the rest layer. In this case, it is assumed that the mass of the elements of the non-magnetic material, generally an oxide or a nitride, of the barrier layer is lighter than the mass of said metallic element. The measure mentioned above positively contributes to the selectivity of the method, in which the selectivity of etching the magnetic material is higher with respect to the non-magnetic material as the charged particles have a heavier mass.

An embodiment of the method according to the invention is characterized in that the electrode layer to be structured is built up from, consecutively, a basic layer and a layer structure comprising at least a further layer for magnetic pinning of the basic layer. The

basic layer may be a ferromagnetic layer, for example, of an NiFe alloy or a Co alloy, particularly a Co-Fe alloy, while the pinning layer structure may comprise one of the following possibilities: an anti-ferromagnetic layer of, for example, an FeMn alloy or an IrMn alloy; a hard-magnetic ferromagnetic layer of, for example, a Co alloy; an artificial anti-ferromagnetic structure comprising two anti-parallel magnetic layers separated by a metallic intermediate layer. Such a structure may be coupled to an anti-ferromagnetic layer of, for example, an FeMn alloy. If such an electrode layer to be structured is formed, it is preferred to selectively etch the layer structure, particularly selectively chemically etch this structure initially, i.e. before the basic layer is structured, until the basic layer is reached. By making partly use of said selective etching, the structuring process in accordance with the method according to the invention can be performed within a shorter period of time. Selective chemical etching is a known etching technique.

It is to be noted that the method according to the invention implies a method of structuring a magnetic electrode layer of a semi-manufactured product of a magnetic tunnel junction device, in which the semi-manufactured product comprises an assembly of said electrode layer, a barrier layer and a further magnetic electrode layer. In the last-mentioned method, the structuring of the relevant layer does not influence the magnetical properties of the other magnetic electrode layer of the magnetic tunnel junction device, at least not in a detrimental sense. The special aspect of this method is that etching does not take place through the barrier layer. It is thereby ensured that, in spite of layer thickness variations and variations of etching methods, the magnetic electrode layer, which is not to be structured, is not etched. The barrier layer, which is an insulating layer, a layer having a low electrical conductance, or a dielectric layer, is usually only approximately 1 nm thick.

The magnetic tunnel junction device according to the invention, manufactured by means of the method according to the invention, has a magnetic electrode layer structured by means of the last-mentioned method and another magnetic electrode layer which may be or may comprise a soft-magnetic layer, which layer is usable as a flux guide. Such a soft-magnetic layer may be formed from, for example, an NiFe alloy or a Co alloy such as a Co-Fe alloy. The soft-magnetic layer may also be built up from a number of sub-layers.

The magnetic field sensor according to the invention is provided with the magnetic tunnel junction device according to the invention. The magnetic tunnel junction device forms one or the transducing element of the magnetic field sensor according to the invention. This sensor may be used, inter alia, as a magnetic head for decoding magnetic flux originating from a magnetic information medium such as a magnetic tape or a magnetic disc;

as a sensor in compasses for detecting the earth's magnetic field; as a sensor for detecting, for example, a position, an angle, or a velocity, for example, in automotive uses; as a field sensor in medical scanners; and as a current detector. Also the magnetic memory, particularly a MRAM, according to the invention is provided with the magnetic tunnel junction device according to the invention.

With regard to the claims, it is to be noted that various combinations of the embodiments mentioned in the dependent claims are possible.

These and other aspects of the invention are apparent from and will be elucidated with reference to the embodiments described hereinafter.

In the drawings:

Fig. 1A shows diagrammatically a first intermediate product obtained from an embodiment of the method according to the invention;

Fig. 1B shows diagrammatically a second intermediate product obtained from said embodiment of the method according to the invention,

Fig. 1C shows diagrammatically a third intermediate product obtained from the embodiment of the method according to the invention,

Fig. 1D shows diagrammatically a fourth intermediate product according to the invention,

Fig. 1E shows diagrammatically an embodiment of the magnetic tunnel junction device according to the invention, made in accordance with the described embodiment of the method according to the invention, and

Fig. 2 shows an embodiment of the magnetic field sensor according to the invention.

Fig. 1A shows a stack 1 of layers which comprises, in this example, a first magnetic electrode layer 3 of a soft-magnetic material, such as an NiFe alloy, an insulating, poorly conducting or dielectric layer 5, in this document also referred to as barrier layer, of, for example Al_2O_3, a second magnetic electrode layer 7 built up in this example of a basic layer 7a of a soft-magnetic material, in this example an NiFe alloy, and a layer structure 7b comprising at least a further layer of an anti-ferromagnetic material such as an FeMn alloy. Alternatively, a hard-magnetic layer may be used as a second magnetic layer for the layer structure comprising the basic layer 7a and the layer structure 7b.

During the method according to the invention, a shielding layer 9 of, for example, a photoresist, see Fig. 1B, is provided on the stack 1 shown. Subsequently, etching processes are used, in which the layer structure 7b is first etched selectively, particularly etched chemically, until the basic layer 7a is reached; see Fig. 1C. Subsequently, the basic layer 7a is etched, particularly etched physically, until a rest layer 7r of soft-magnetic material remains; see Fig. 1D. Alternatively, instead of two etching processes, it may be sufficient to use physical etching only. Physical etching such as sputter etching is preferably also used if the second electrode layer 7 is a hard-magnetic layer. During physical etching, resistance measurements are performed continuously or occasionally, possibly during a short interruption of the etching process, so as to determine when the desired rest layer 7r is reached.

The rest layer 7r obtained in one of the methods described above preferably has a thickness of 5 nm maximum. During the method according to the invention, the rest layer 7r is removed by physical etching, in this example sputter etching, in which charged particles, particularly ions, have a motion energy which is between the sputtering threshold of the NiFe alloy used and the sputtering threshold of Al_2O_3. The sputtering threshold of the NiFe alloy is approximately 20 eV; the sputtering threshold of Al_2O_3 is approximately 40 eV. In this embodiment, the rest layer 7r is preferably bombarded with Kr or Xe ions which ions have a mass which is heavier than the mass of the metals Ni and Fe, which mass is in its turn heavier than the mass of Al and O. After removal of the rest layer 7r, a protective layer 11 may be formed by depositing an insulating material such as SiO_2 or Al_2O_3. The shielding layer 9 may be removed.

The magnetic field sensor according to the invention, shown in Fig. 2, comprises a magnetic tunnel junction device 20 of the type shown in Fig. 1E. In this embodiment, the sensor also comprises a magnetic yoke 22 which has an interruption 22a which is bridged and is in magnetic contact with the tunnel junction device 20. The magnetic yoke 22 is formed from a soft-magnetic material such as an NiFe alloy. The sensor has a sensor face 24 adjacent to a non-magnetic transducing gap 26. The interruption 22a and the gap 26 are formed by insulating layers of, for example SiO_2 or Al_2O_3.

It is to be noted that the invention is not limited to the embodiments shown. For example, variants of the several steps of the method are possible within the scope of the invention. Furthermore, the sensor shown may be formed as a magnetic head for scanning a magnetic recording medium. Such a construction may form part of a combined read/write head. The magnetic tunnel junction device obtained in accordance with the method of the invention may also form part of a magnetic memory.

CLAIMS:

1. A method of manufacturing a magnetic tunnel junction device, in which a stack comprising two electrode layers, comprising a magnetic material, and a barrier layer extending in between, comprising a non-magnetic material, is formed, characterized in that one of the electrode layers is structured by means of etching, in which, during etching, a part of the relevant layer is made thinner by removing material until a rest layer remains, whereafter said rest layer is removed by means of physical etching, in which at least substantially particles have a motion energy which is between the sputtering threshold of the magnetic material of the rest layer and the sputtering threshold of the non-magnetic material of the barrier layer.

2. A method as claimed in claim 1, characterized in that particles are used which have a mass which is heavier than the mass of a metallic element of the magnetic material of the rest layer.

3. A method as claimed in claim 1, characterized in that the electrode layer to be structured is built up from, consecutively, a basic layer and a layer structure comprising at least a further layer for magnetic pinning of the basic layer.

4. A method as claimed in claim 3, characterized in that, prior to structuring the basic layer, the layer structure is chemically etched until the basic layer is reached.

5. A magnetic tunnel junction device obtained by means of the method as claimed in any one of the preceding claims.

6. A magnetic tunnel junction device as claimed in claim 5, in which the layer other than the structured electrode layer comprises a soft-magnetic layer which is usable as a flux guide.

7. A magnetic field sensor provided with the magnetic tunnel junction device as claimed in claim 5.

8. A magnetic field sensor provided with the magnetic tunnel junction device as claimed in claim 6 and provided with a magnetic yoke which is in magnetic contact with the soft-magnetic layer of the magnetic tunnel junction device.

5

9. A magnetic memory provided with the magnetic tunnel junction device as claimed in claim 5.

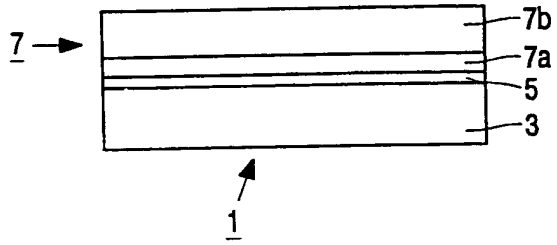


FIG. 1A

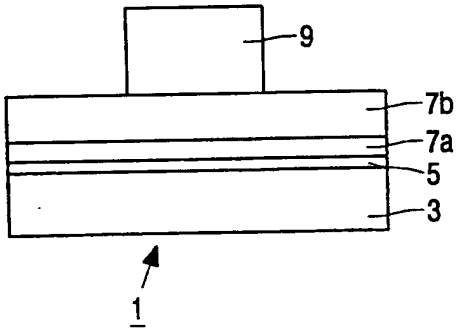


FIG. 1B

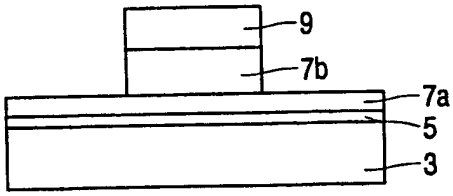


FIG. 1C

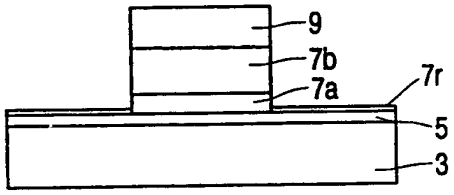


FIG. 1D

FIG. 1E

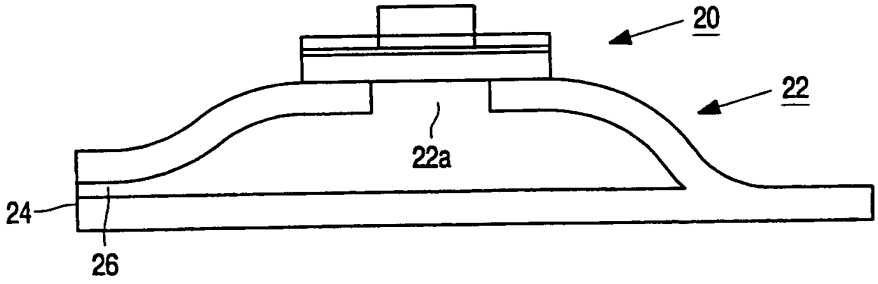


FIG. 2

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
PHN 17.557WO		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/EP 00/ 06817	17/07/2000	22/07/1999
Applicant		
KONINKLIJKE PHILIPS ELECTRONICS N.V.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language,** the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1d

   [ ] as suggested by the applicant.

   [ ] because the applicant failed to suggest a figure.

   [X] because this figure better characterizes the invention.

   [ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 00/06817

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01F41/32 G11B5/31

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01R H01F H01L G11B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A ✓	WO 99 22368 A (KONINKL PHILIPS ELECTRONICS NV ;PHILIPS AB (SE)) 6 May 1999 (1999-05-06) cited in the application	1
X	abstract; claim 1; figures	5-9
A ✓	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 05, 31 May 1999 (1999-05-31) & JP 11 054814 A (NEC CORP), 26 February 1999 (1999-02-26) abstract; figures 3,7	1
A ✓	US 5 492 605 A (PINARBASI MUSTAFA) 20 February 1996 (1996-02-20) abstract	1

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 November 2000	24/11/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Fritz, S

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Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 00/06817

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A,P	US 5 949 623 A (LIN TSANN) 7 September 1999 (1999-09-07) abstract; figure 5	1

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 00/06817

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9922368 A	06-05-1999	EP 0948788 A	13-10-1999
JP 11054814 A	26-02-1999	NONE	
US 5492605 A	20-02-1996	NONE	
US 5949623 A	07-09-1999	US 6030753 A	29-02-2000

⑲日本国特許庁(JP)　⑪特許出願公開

⑫公開特許公報(A)　平3−283453

⑤1Int. Cl.[5]	識別記号	庁内整理番号	⑬公開　平成3年(1991)12月13日
H 01 L 23/29 23/28 23/31	H	6412−4M	
		6412−4M　H 01 L 23/30　Z	

審査請求　未請求　請求項の数 2　(全4頁)

⑤4発明の名称　樹脂封止型半導体装置

⑳特　願　平2−81036
㉒出　願　平2(1990)3月30日

⑦2発　明　者　岡　　隆　弘　東京都港区虎ノ門1丁目7番12号　沖電気工業株式会社内
⑦1出　願　人　沖電気工業株式会社　東京都港区虎ノ門1丁目7番12号
⑦4代　理　人　弁理士　清水　守　外1名

明　細　書

1．発明の名称

樹脂封止型半導体装置

2．特許請求の範囲

(1)ベントホールが形成される樹脂封止型半導体装置において、

前記ベントホールにより露出したダイパッドに封止樹脂よりも吸湿能力の高い吸湿材を接着してなることを特徴とする樹脂封止型半導体装置。

(2)前記吸湿材が吸湿度合に応じて変色する材料からなる請求項1記載の樹脂封止型半導体装置。

3．発明の詳細な説明

(産業上の利用分野)

本発明は、樹脂封止型半導体装置の構造に関するものである。

(従来の技術)

従来、このような分野の技術としては、例えば以下に示すようなものがあった。

第3図はかかる従来の樹脂封止型半導体装置の断面図である。

ここでは、基板上に設けられたフットプリント上に表面実装されるガルウィング型のリードを有するパッケージ(QFP: Quad Flat Package、又は、SOP: Small Outline Package)を示している。

この図において、1は半導体素子であり、個辺に分割された後、共晶又は接着材等により半導体素子搭載部(以下、ダイパッドという)2aに固着される。続いて、金属等のワイヤ4を用いてインナリード2bと配線パッド3とを接続し、エポキシ系樹脂等の熱硬化性樹脂5で封止する。更に、アウタリード2cに対し、半田等の端子処理及び曲げ加工を施すことによって製品を得る。

この樹脂封止型半導体装置の特徴として、ダイパッド2aの下に穴(以下、ベントホールという)6が形成されていることが挙げられる。このようなベントホールが設けられる理由について、以下に説明する。

先に述べたように、この樹脂封止型半導体装置は、エポキシ系樹脂等の熱硬化性樹脂5を用いて

構成されている。この熱硬化型樹脂5は水分を吸収する性質を持っているため、この熱硬化型樹脂5で封止された半導体装置は、室内に保管されているだけで水分を徐々に吸収するということは周知の事実である。ここで吸収された水分は、熱硬化性樹脂5と金属であるダイパッド2aやインナリード2bの界面に蓄積される。このような状態の下でこの樹脂封止型半導体装置を基板上に半田付けすると、上記吸収された水分が、半田の熱によって蒸気化し、急激に膨張する。この時、その装置に水分を逃がす構造がないと、水分の急激な膨張により、その装置の樹脂部分が膨れ、最悪の場合、クラック（亀裂）が生じたり、配線されたワイヤが断線する等、装置自体の信頼性上の問題がある。

この問題を解決するために設けられたのが、ベントホールである。このようにベントホールを設けることにより、樹脂封止型半導体装置の半田付けの際に生じる水分の急激な膨張を逃し、上記クラックや断線をなくすことができ、装置の信頼性を向上させることができる。

（発明が解決しようとする課題）

しかしながら、以上述べた樹脂封止型半導体装置構造においても、近年の半導体素子の大型化に伴い、以下のような問題点があった。

半導体装置の外形サイズに対して、搭載する半導体素子がある範囲を超えた場合、ダイパッドも大型化するため、ダイパッド下に吸湿される水分の量も増加する。従って、半田付け等の熱による吸湿した水分の急激な膨張圧力も増大し、ベントホールによって逃がすだけでは、樹脂部分の膨れやクラックや断線といった信頼性上の問題を完全に除去できなくなってきた。

従って、その対策として、次の2点が、ベントホール構造と併せて講じられる。

(1) 基板実装直前に乾燥させることにより、吸湿した水分を減少させる。

(2) アルミラミネート等を施した防湿袋に、半導体装置とシリカゲル等の乾燥剤を封入し、保管中の吸湿を防止すると共に、開封後は一定時期間内に基板に実装する。

しかし、いずれの対策もその取扱を使用者側に一任しなくてはならず、上記(2) の場合も一定期間を超えて保管された場合、乾燥剤の吸湿能力を超え、樹脂が水分を吸湿することは避けられず、一定期間後、基板に実装するためには、再度乾燥処理をする必要が生じる。

また、半導体装置がどの程度水分を吸湿したかを判定することは大変困難であり、使用者側における半導体装置の吸湿量の管理も完全とは言えない。

従って、以上の対策だけでは、不十分であった。

本発明は、上記問題点を除去し、樹脂部分の膨れ、クラックや断線を防止することができる品質の優れた信頼性の高い樹脂封止型半導体装置を提供することを目的とする。

（課題を解決するための手段）

本発明は、上記目的を達成するために、ベントホールが形成される樹脂封止型半導体装置において、前記ベントホールにより露出したダイパッドに封止樹脂よりも吸湿能力の高い吸湿材を接着するようにしたものである。

また、前記吸湿材は吸湿度合に応じて変色する材料を用いる。

（作用）

本発明によれば、上記したように、ベントホールが設けられた樹脂封止型半導体装置において、そのダイパッド裏面（素子搭載側と反対側）のベントホールによる露出部分全面、又は一部に樹脂成形に採用される樹脂よりも、吸湿効果の著しく高い吸湿材（例えば、高分子吸湿材、又はシリカゲルを含んだ材料等）を接着材等により接着する構造にすることにより、(1) 室温保管等により生じる水分の吸湿分は、装置を構成する樹脂より吸湿効果の著しく高いダイパッド裏面の吸湿材に集中して吸湿されるため、半田付け等の熱による吸湿した水分の急激な膨張は、完全にベントホールより逃がすことができる。そのため、樹脂部分の膨れ、クラックや断線を搭載される半導体素子の大きさにかかわらず防止することができる。(2)

更に、吸湿材として、例えば、シリカゲル等の材料を選定することにより、吸湿材の吸湿能力を超えた場合は、ベントホールから露出している吸湿材の色の変化等により、そのことを使用者側に明示することができる。

（実施例）

以下、本発明の実施例について図面を参照しながら詳細に説明する。

第1図は本発明の実施例を示す樹脂封止型半導体装置の断面図、第2図はその樹脂封止型半導体装置の裏面図である。

これらの図に示すように、半導体素子1をダイパッド2aに固定接着し、配線用パッド3とインナリード2bをワイヤ4で接続し、封止用樹脂5により、樹脂成形され、アウタリード2cを加工する。

ここで、ダイパッド2aの素子搭載側と反対面の中心部には、従来構造と同様に、ベントホール6が形成される。更にそのベントホール6により露出しているダイパッド部2aには、封止用樹脂5に比べ、著しく吸湿能力の高い吸湿材（例えば、高分子吸湿材又はシリカゲルを含んだ材料等）7を接着材等により接着する。

従って、この樹脂封止型半導体装置が室温保管等をされた場合においても、大気中の水分は吸湿材7が封止樹脂5より、はるかに水分を吸湿しやすいことから吸湿材7が水分を吸湿し、封止樹脂5はほとんど吸湿しない。

このように、吸湿材7が吸湿能力を超えるまでは、水分はダイパッド裏面の吸湿材7に集中しているため、半田付け等の熱による水分の急激な膨張は、ダイパッド裏面のベントホール部に集中し、ベントホールの効果が完全に発揮されることになる。この時、吸湿材の大きさはベントホールと同一、もしくはやや小さめにするのが望ましく、また、封止用樹脂との密着性は悪いことが望ましい。

第2図に示すように、ベントホール6により露出されている吸湿材7は、外部から目視することができる。従って、吸湿材としてシリカゲルを含んだ材料等を選定することにより、その吸湿材の色が変化することにより、その吸湿材が水分を十分に吸湿し、その能力の限界を超えたことが判定できるようにすることも可能である。例えば、シリカゲルの例で示すと、吸湿していない状態の吸湿材は青色であり、吸湿するに伴って変色し、ピンク色となったところで限界を超える。従って、吸湿材がピンクになるまでは、そのまま基板実装可能であり、ピンクになったところで、基板実装前に乾燥すれば良い。

また、シリカゲル等は一度吸湿能力の限界を超えても、乾燥すれば再び、吸湿能力を発揮するようになるため大変都合が良い。

なお、ベントホールの形状、大きさは半導体装置の大きさなどに応じて任意に設定することができる。

また、本発明は上記実施例に限定されるものではなく、本発明の趣旨に基づいて種々の変形が可能であり、これらを本発明の範囲から排除するものではない。

（発明の効果）

以上、詳細に説明したように、本発明によれば、ベントホールにより露出したダイパッド裏面部に、封止用樹脂より著しく吸湿する特性をもった吸湿材を接着する構造としたので、吸湿材がその能力を発揮している間は、水分は吸湿材に集中して吸湿されるため、搭載する半導体装置の大きさにかかわらず、半田付け等の熱により生じる水分の急激な膨張をベントホールから完全に逃がすことができる。

従って、樹脂部分の膨れ、クラックや断線を防止することができる。

また、吸湿材の選定によっては、その吸湿能力を超えたことを、吸湿材の色の変化により、使用者側において容易に判定することができる。

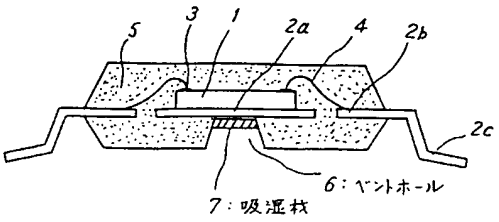
4．図面の簡単な説明

第1図は本発明の実施例を示す樹脂封止型半導体装置の断面図、第2図はその樹脂封止型半導体装置の裏面図、第3図は従来の樹脂封止型半導体装置の断面図である。

1…半導体素子、2a…ダイパッド、2b…イ

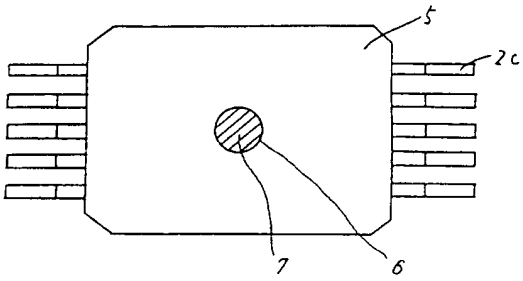
ンナリード、2c…アウタリード、3…配線用パッド、4…ワイヤ、5…封止用樹脂、6…ベントホール、7…吸湿材。

特許出願人　沖電気工業株式会社
代理人　弁理士　清水　守（外1名）



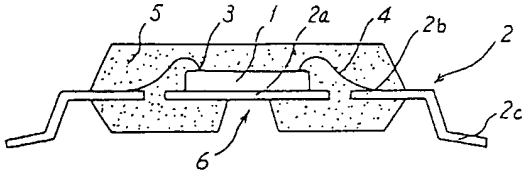
本発明の樹脂封止型半導体装置の断面図

第 1 図



本発明の樹脂封止型半導体装置の裏面図

第 2 図



従来の樹脂封止型半導体装置の断面図

第 3 図